N1000A DCA-X and N1002A Optimization Controller

Wide Bandwidth Oscilloscope Mainframe, Modules, and N1002A Optimization Controller



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Introduction

N1000A DCA-X

The N1000A DCA-X performs precision measurements on high speed digital designs from 50 MBd to more than 80 GBd on up to 16 channels simultaneously. Applications include optical transceiver design and production test, electrical ASIC/FPGA/IC design and characterization, serial bus characterization, and measurements and trouble-shooting via TDR/TDT and S-parameter measurements of channels, cables and PCBs.

The N1000A user interface and operating system is identical to the FlexDCA interface of the DCA-M modules (over a simple USB 2.0 or 3.0 connection) and N1010A FlexDCA on a PC.

N1002A DCA-M Optimization Controller

The N1002A DCA-M Optimization Controller is a rack-mountable PC controller. Use the N1002A with FlexOTO and FlexDCA software to maximize measurement thoughtput and minimize setup time when testing 800G and 1.6T modules and performing tests such as 25/53 GBd PAM4 OER, OOMA, and TDECQ. When using multiple DCA-M oscilloscopes and clock recovery modules, the N1002A solution maximizes hardware utilization by sharing the DCA-M oscilloscope between multiple DUT fixtures in the most efficient manner.

Digital Communication Analyzer Solutions

Keysight offers complete Digital Communication Analyzer solutions that can be combined with or used alongside the DCA-X, including clock recovery, stand-alone Digital Communication Analyzers (DCA-M) and software. For complete information on Keysight's entire DCA family, please refer to these other helpful documents:

- Keysight DCA Wide Bandwidth Oscilloscope Family Brochure (5992-3301EN)
- Keysight DCA Family FlexDCA Sampling Oscilloscope Software Technical Overview (5992-3319EN)
- Keysight N1000A DCA Wide Bandwidth Oscilloscope Family Configuration Guide (5992-3372EN)
- Keysight DCA Family Clock Data Recovery Solutions Data Sheet (5991-1620EN)
- Keysight N1090A (5992-3655EN), N1092A/B/C/D/E (5992-3886EN), and N1094A/B (5992-3700EN) DCA-M Optical and Electrical Sampling Oscilloscope Data Sheets.
- Keysight FlexOTO Optical Test Optimization Software and Solutions Flyer (3123-1111EN)



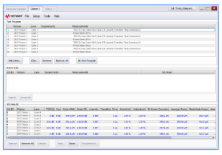
Optical + Electrical and Electrical Clock Recovery



Optical + Electrical DCA-M



FlexDCA Software



FlexOTO Software

N1000A DCA-X Specifications

General notes



NOTE: All specifications describe warranted performance over the temperature range +10°C to + 40°C (unless otherwise noted). The specifications are applicable after the temperature is stabilized, which occurs after 1 hour of continuous operation in final setup configuration and while self calibration is valid. Many performance parameters are enhanced through frequent, simple user calibrations.

NOTE: Specifications describe warranted performance. Characteristics provide useful, nonwarranted information about the functions and performance of the instrument. Characteristics are printed in *green italics*.

NOTE: Factory Calibration Cycle. For optimum performance, the instrument should have a complete verification of specifications once every 12 months.

NOTE: Nominal Value indicates the expected, but not warranted, value of the parameter.

N1000A computer system and storage specifications

Item	Description
CPU	Intel I5 Quad Core
RAM	8 GB
Operating System	Windows 10, 64 bit
Mass Storage	240 GB (minimum) internal SSD hard disk

N1000A display specifications

Item	Description
Display Area	210.4 mm x 157.8 mm 10.4 inch diagolnal color active matrix LCD module incorporating amorphous silicon TFTs.
Entire Display Resolution	1024 pixels horizontally x 768 pixels vertically
Waveform Colors	Select from over 16 colors. User may change color assignment of all traces (channels, waveform memory, and signal processing functions).
Persistence Modes	Gray scale, color grade, infinite, variable
Connect-the-dots	On/Off selectable
Persistence	Minimum, variable (100 ms to 40s), infinite
Graticule	On/Off

Grid Intensity	0 to 100%
Dialog Boxes	Opaque or transparent
Supports External Display	Supports multiple display configurations via Windows display utility.

N1000A environmental specifications

Item	Description
Use	indoor
Temperature	
Operating	10 °C to +40 °C (50 °F to +104 °F)
Non-operating	–40 °C to +70 °C (–40 °F to +158 °F)
Altitude (Operating)	Up to 4,600 meters (15,000 ft)
Humidity [1]	Type tested at 95%, +40 °C (non-condensing)
Weight	
Mainframe without modules (characteristic)	*20.5 kg (43 lb)*
Module (characteristic)	*1.2 kg (2.6 lb)*
Dimensions (excluding handle)	
Without front connectors and rear feet	221 mm H x 426 mm W x 530 mm D (8.7 inch x 16.76 inch x 20.9 inch)
With front connectors and rear feet	234 mm H x 426 mm W x 601 mm D (9.23 inch x 16.76 inch x 23.67 inch)
With front cover and rear feet	234 mm H x 426 mm W x 612 mm D (9.23 inch x 16.76 inch x 24.1 inch)

1. Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of Storage, Transportation and End-use; those stresses include but are not limited to temperature, humidity, shock, vibration, altitude and power line conditions. Test Methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3.

N1000A LINE power specifications

Item	Description
Line Power	100/120 Vac, 50/60/400 Hz
	220/240 Vac, 50/60 Hz
Power in Watts	700 Watts Maximum
The products can operate with mains supply voltage fluctuations up to ± 10% of the nominal voltage.	

N1000A horizontal (timebase) specifications

Item	Description
Scale Factor	**Full scale is ten divisions.**
Minimum	100 fs/div
Maximum	50 ms/div
Delay	**Time offset relative to the front panel trigger input on the instrument mainframe.**
Minimum	16 ns
Maximum	1s
Time Interval Accuracy	1 ps + 1% of Δ time interval for intervals from minimum delay to minimum delay + 1 ns [1], *or* 6 ps + 1% of Δ time interval [1]
	500 fs + 0.25% of Δ time interval (characteristic) [2]
Time Interval Accuracy (Pattern Lock Mode)	1 GHz to 32 GHz: 500 fs + 0.5% of 1 / (clock input frequency), *or* 5 ps (whichever is smaller) [1]
	50 MHz to 1 GHz: 500 fs + 0.5% of 1 / (clock input frequency), *or* 30 ps (whichever is smaller) [1]
	250 fs + 0.25% of 1 / (clock input frequency) (characteristic) [2]
Jitter Mode Operation	*Time interval accuracy – jitter mode operation 500 fs (characteristic).* Test configuration: PRBS of length 2^7–1 bits, Data and Clock 10 Gb/s.
Time Interval Resolution [3]	*screen diameter / record length or 60 fs, whichever is larger*
Display Units	Unit Interval or Time
Record length [4]	16 to 131,072 without pattern lock, 1 to 268,435,456 with pattern lock and "Acquire Entire Pattern"

1. Dual marker measurement performed at a temperature within ± 5 °C of horizontal calibration temperature.
2. Dual marker measurement performed at a temperature within ± 1.5 °C of horizontal calibration temperature.
3. The time interval resolution is the smallest time you can characterize between two points.
4. Maximum number of samples depends on pattern, number of active channels, available memory, pattern lock enabled, and *Acquire Entire Pattern* enabled.

N1000A front-panel inputs and outputs opecifications

Item	Description
Trigger Input, Connector	2.92 mm (male) Mainframe ships with 2.92 mm female-female connector saver (P/N 1250-4105)
Trigger Input, Impedance (Normalized)	50 Ω
Trigger Input, Maximum	2 Vpp maximum
Precision Timebase Input, Connector *(Option N1000A-PTB only)*	2.92 mm (male) Mainframe ships with 2.92 mm female-female connector saver (P/N 1250-4105).
Precision Timebase Input, Impedance (Normalized) *(Option N1000A-PTB only)*	50 Ω
Precision Timebase Input, Maximum *(Option N1000A-PTB only)*	1.3 Vpp maximum
DC Cal Output	BNC (female) Range: –2.0 V to +2.0 V
USB	Three USB 2.0 ports
Ground Connection	Banana plug

N1000A rear-panel inputs and outputs specifications

Item	Description
GPIB	Fully programmable, complies with IEEE 488.2
Display Port	For connecting external displays
VGA Port	Analog, full color, 15 pin D-sub (female)
LAN	Two Gigabit Ethernet ports
USB	Two USB 3.0 ports Two USB 2.0 ports
USB Device Port	Instrument control over USB

N1000A internal precision timebase specifications (Option PTB)

The *N1000A Internal Precision Timebase Specifications* are for Option PTB, which is the N1000A internal precision timebase. These specifications refer to the signal input to the front-panel Precision Timebase Input connector.

NOTE: If Freerun trigger mode is *not* used, a trigger input *must* also be supplied. This is in addition to the reference clock input to the front-panel Precision Timebase connector. The trigger input must be synchronous to the reference clock but may be a sub-rate of the clock based on the required frequency range for the trigger input.

Item	Description
Maximum Input Signal	1.3 Vpp
Input DC Offset Range	± 200 mV
Input Signal Type The internal precision timebase works with typical digital clock signals, such as a BERT output, as well as sine waves. If the rise time or fall time of the clock signal is less than 15% of the period of the clock (for example, less than 15 ps for a 10 GHz clock), reduce the edge speed by using an external low-pass filter or length of cable. For the lowest jitter, use a signal that is as close as possible to the maximum signal amplitude (1.3 Vpp) and minimize any sub-harmonics.	
Jitter (Input ≥ 750 mVpp, sinusoidal) *(Characteristic)*	
2.4 GHz to < 4.0 GHz trigger (tested at 2.4 GHz, 750 mVpp)	*≤ 200 fs rms* *< 400 fs rms*, with 54XXX, 8348X, or N1045A *(non Option LOJ)* module
4 GHz to 9.0 GHz trigger (tested at 5 GHz, 750 mVpp)	*≤ 120 fs rms* *< 400 fs rms*, with 54XXX, 8348X, or N1045A *(non Option LOJ)* module
> 9.0 GHz to 44.0 GHz trigger (tested at 10, 20, and 40 GHz, 500 mVpp)	*≤ 90 fs rms* *< 200 fs rms*, with 54XXX, 8348X, or N1045A *(non Option LOJ)* module
Precision Timebase Input	
Nominal Impedance	*50 Ω*
Connector Type	2.92 mm (male)

N1000A general trigger specifications

Item	Description
Maximum Trigger Signal	2 V peak-to-peak
Trigger Input	
Nominal Impedance	*50 Ω*
Reflection	*10% for 100 ps rise time*
Connector Type	2.92 mm (male)

N1000A internal trigger mode specifications

Item	Description
Freerun	Freerun trigger mode internally generates an asynchronous trigger that allows viewing the sampled signal amplitude without an external trigger signal but provides no timing information. Freerun is useful in troubleshooting external trigger problems.

N1000A clock trigger / pattern lock mode specifications

Item	Description [1]
Clock Trigger	50 MHz to 32 GHz, effective divide-by-one, AC coupled
Pattern Lock (Option PLK)	50 MHz to 32 GHz, AC coupled
Pattern Lock Length (Option PLK)	1 to 2^{23} (8,388,608) symbols
Jitter	
50 MHz to < 500 MHz	1.0 ps rms + 10 PPM of horizontal position (maximum) *< 800 fs rms + 5 PPM of horizontal position (typical)*
500 MHz to 32 GHz [2,3] (Option STB)	450 fs rms (maximum) *400 fs rms (typical)*
500 MHz to 32 GHz [2,3] (Option LOJ)	250 fs rms (maximum) *200 fs rms (typical)*
Trigger Sensitivity	200 mV p-p
Trigger Slew rate	≥ 2 V/ns

1. These specifications refer to the signal input to the front-panel Trigger Input connector. The sampled input signal timing is recreated by using an externally supplied trigger signal that is synchronous with the sampled signal input.
2. Verified at 10 GHz with a clock and signal slew rate ≥ 15 V/ns.
3. Verified at 28 GHz with a clock and signal slew rate ≥ 20 V/ns.

N1000A edge trigger mode specifications

Item	Description [1]
Input	DC to 2.5 GHz
Jitter [2]	1.0 ps rms + 10 PPM horizontal position (maximum) *< 800 fs rms + 5 PPM horizontal position (characteristic)*
Trigger Sensitivity	200 mV p-p (sinusoidal input or 200 ps minimum pulse width)
Triggering Level Adjustment	–1 V to +1 V
Edge Select	Positive or negative

1. These specifications refer to the signal input to the front-panel Trigger Input connector. The sampled input signal timing is recreated by using an externally supplied trigger signal that is synchronous with the sampled signal input.
2. Verified at 2.5 GHz with a clock and signal slew rate ≥ 2 V/ns.

N1000A vertical (channel) specifications

Item	Description
Sample Rate	Up to 250 kHz
Number of Channels	Up to 16 channels
Vertical Resolution	16 bit hardware A/D converter for N10xx-series modules. 14 bit hardware A/D converter for 861xx, 54xxx, and 8348x-series modules.
Full Resolution Channel Scales	Adjusts in a 1-2-5-10 sequence for coarse adjustment or fine adjustment resolution from the front panel knob.
Adjustments	Scale, offset, activate filter, sampler bandwidth, attenuation factor, transducer conversion factors

N1002A Optimization Controller Specifications

General notes



NOTE: All specifications describe warranted performance over the temperature range +10°C to + 40°C (unless otherwise noted). The specifications are applicable after the temperature is stabilized, which occurs after 1 hour of continuous operation in final setup configuration and while self calibration is valid. Many performance parameters are enhanced through frequent, simple user calibrations.

NOTE: Specifications describe warranted performance. Characteristics provide useful, nonwarranted information about the functions and performance of the instrument. Characteristics are printed in *green italics*.

NOTE: Factory Calibration Cycle. For optimum performance, the instrument should have a complete verification of specifications once every 12 months.

NOTE: Nominal Value indicates the expected, but not warranted, value of the parameter.

N1002A computer system and storage specifications

Item	Description
CPU	Intel i7 Octal-Core
RAM	32 GB
Operating System	Win10 LTSC, 64-bit
Mass Storage	480 GB SSD

N1002A environmental specifications

Item	Description
Use	indoor
Temperature (Operating)	10 °C to +40 °C (50 °F to +104 °F)
Temperature (Non-operating)	–40 °C to +70 °C (–40 °F to +158 °F)
Altitude (Operating)	Up to 4,600 meters (15,000 ft)
Humidity [1]	Type tested at 85%, +40 °C (non-condensing)
Weight	*6.5 kg (14.4 lbs), characteristic*
Dimensions (excluding handle)	101 mm H x 426 mm W x 491 mm D (3.98 inch x 16.77 inch x 19.33 inch)

1. Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of Storage, Transportation and End-use; those stresses include but are not limited to temperature, humidity, shock, vibration, altitude and power line conditions. Test Methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3.

N1002A LINE power specifications

Item	Description
Line Power	100/120 Vac, 50/60 Hz
	220/240 Vac, 50/60 Hz
Power in Watts	185 Watts Maximum
The products can operate with mains supply voltage fluctuations up to ± 10% of the nominal voltage.	

N1002A front-panel inputs and outputs specifications

Item	Description
USB	Three USB 3.0 ports

N1002A rear-panel inputs and outputs specifications

Item	Description
GPIB	Fully programmable, complies with IEEE 488.2
Display Port	For connecting external displays
VGA Port	Analog, full color, 15 pin D-sub (female)
LAN	Two Gigabit Ethernet ports
USB	Eight USB 3.0 ports
USB Device Port	Instrument control over USB

Module Selection Guides

Optical / electrical modules

Module	Option	No. of electrical channels	Highest electrical bandwidth (GHz)	No. of optical channels	Wavelength range (nm)	Unfiltered optical bandwidth (GHz)	Fiber input (µm)
N1030A		0		1	1250 - 1600	65	9/125
	EC1	1	95	1	1250 - 1600	65	9/125
N1030B		0		2	1250 - 1600	65	9/125
N1032A	09U	0		1	1250 - 1625	90	9/125
	13U	0		1	1250 - 1625	110 *120 (characteristic)*	9/125
N1032B	09U	0		2	1250 - 1625	90	9/125
	13U	0		2	1250 - 1625	110 *120 (characteristic)*	9/125

Available optical reference filter rates for optical modules (NRZ)

Module	20 Gb/s to 28 Gb/s	49.77 Gb/s[1] (37.3 GHz)	106.25 Gb/s (53.125 GHz)
N1030A	●	●	
N1030B	●	●	
N1032A			●
N1032B			●

1. With option 490.

Available optical reference filter rates for optical modules (PAM4)

Module	26 Gb/s[1]	49.7664 Gb/s (37.3248 GHz)	53 Gb/s[1]	106.25 Gb/s (53.125 GHz)	112.5 Gb/s (56.25 GHz)
N1030A	●		●		
N1030B	●		●		
N1032A		●		●	●
N1032B		●		●	●

1. Only available with option IRC.

Electrical modules

Module	Option	No. of electrical channels	Highest Electrical bandwidth (GHz)	Step Generator (TDR)
N1040A	033	2	33	
	060	2	60	
N1045B	02x	2	60	
	04x	4	60	
N1046A	71F	1	75	
	72F	2	75	
	74F	4	75	
	81F	1	85	
	82F	2	85	
	84F	4	85	
	11F	1	100	
	12F	2	100	
	14F	4	100	
N1055A	32x	2	35	2
	34x	4	35	4
	52x	2	50	2
	54x	4	50	4
N1060A	050	2	50	
	085	2	85	

Module SIRC Filters

System Impulse Response Correction (SIRC) filters provide channel SIRC measurement and data files to give an ideal channel response. SIRC data can be applied in FlexDCA's System Impulse Response Correction dialog. The SIRC correction data feature is a digital filter that is used to:

- Improve the response of module reference filters to more closely match an ideal receiver.
- Enable non-standard reference receiver rates or bandwidths.
- Increase the bandwidth of the channel by up to 50%.
- Ensures that an eye diagram will look identical between different modules.

SIRC correction data is unique to a specific 86116C serial number. The data can be purchased with new modules or purchased as an upgrade for your existing modules. Purchasing data for an existing module requires that the module be returned to Keysight Technologies. To order SIRC data, contact your Keysight representative or visit http://www.keysight.com/Find/FlexDCA.

NOTE: The SIRC filter ranges shown in the following tables are only available with option IRC and compliance is not guaranteed.

N1030A/B SIRC filter ranges

Module/Option	Channel	Range[1] Min SIRC Freq.	Range[1] Max SIRC Freq.
N1030A Option 560	All Optical	21.5 GBd (16.13 GHz)	80 GBd (60 GHz)
N1030A Options 280 *and* 560	All Optical	15.6 GBd (11.7 GHz)	80 GBd (60 GHz)
N1030A Option EC1	Electrical	20 GHz	127 GHz

1. Only available with option IRC and compliance not guaranteed.

N1032A/B SIRC filter ranges

Module/Option	Channel	Range[1] Min SIRC Freq.	Range[1] Max SIRC Freq.
N1032A/B Option 09U, IRC	All	33.3 GHz dBo (25 GHz dBe)	90 GHz dBo (67.5 GHz dBe)
N1032A/B Options 09U, 112, IRC	All	33.3 GHz dBo (25 GHz dBe)	106.25 GHz dBo (79.68 GHz dBe)
N1032A/B Options 09U, 13U, 112, IRC	All	33.3 GHz dBo (25 GHz dBe)	130 GHz dBo (97.5 GHz dBe)

1. Only available with option IRC and compliance not guaranteed.

N1040A SIRC filter ranges

Module/Option	Channel	Range[1] Min SIRC Freq.	Range[1] Max SIRC Freq.
N1040A Option 033	All	10 GHz	38 GHz
N1040A Option 060	All	10 GHz	70 GHz

1. Only available with option IRC and compliance not guaranteed.

N1045B SIRC filter ranges

Module/Option	Channel	Range[1] Min SIRC Freq.	Range[1] Max SIRC Freq.
N1045B	All	10 GHz	70 GHz

1. Only available with option IRC and compliance not guaranteed.

N1046A SIRC filter ranges

Module/Option	Channel	Range[1] Min SIRC Freq.	Range[1] Max SIRC Freq.
N1046A Option 1xF	All	22.5 GHz	130 GHz
N1046A Option 7xF	All	22.5 GHz	80 GHz
N1046A Option 8xF	All	22.5 GHz	90 GHz

1. Only available with option IRC and compliance not guaranteed.

N1060A SIRC filter ranges

Module/Option	Channel	Range[1] Min SIRC Freq.	Range[1] Max SIRC Freq.
N1060A Option 050	All	25 GHz	60 GHz
N1060A Option 085	All	25 GHz	100 GHz
N1060A Option E33, 050	All	16.5 GHz	60 GHz
N1060A Option E33, 085	All	16.5 GHz	100 GHz

1. Only available with option IRC and compliance not guaranteed.

Module Specifications

NOTE: All specifications describe warranted performance over the temperature range +10°C to + 40°C (unless otherwise noted). The specifications are applicable after the temperature is stabilized, which occurs after 1 hour of continuous operation in final setup configuration and while self calibration is valid. Many performance parameters are enhanced through frequent, simple user calibrations.

NOTE: Specifications describe warranted performance. Characteristics provide useful, nonwarranted information about the functions and performance of the instrument. Characteristics are printed in *green italics*.

NOTE: Factory Calibration Cycle. For optimum performance, the instrument should have a complete verification of specifications once every 12 months.

NOTE: Nominal Value indicates the expected, but not warranted, value of the parameter.

N1030A/B module specifications



N1030A/B optical channel specifications

Item	Description
Optical Channel Count	1 (N1030A) 2 (N1030B)
Optical Channel Bandwidth, −3 dBo	*65 GHz (characteristic)* [1] 60 GHz [2]
Nominal Wavelength Range	1250 nm to 1600 nm
Factory calibrated wavelengths [3]	1310 nm (± 20 nm) 1550 nm (± 20 nm)
User calibration wavelength range	1250 nm to 1600 nm

Reference receiver filters [4]
25 Gb/s Ethernet (25.78125 Gb/s) 400GBASE-SR16 (26.5625 Gb/s) Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s) 32G Fibre Channel (28.05 Gb/s) 49.77 Gbaud NRZ ITU-T 50G-PON (37.3 GHz) - Option 490 53.125 GBaud PAM4 TDECQ (26.6 GHz) 53.125 GBaud NRZ (39.8 GHz)

RMS Noise *(Characteristic)*	**1310 nm**	**1550 nm**
25 Gb/s Ethernet (25.78125 Gb/s)	*16 µW*	*18 µW*
400GBASE-SR16 (26.5625 Gb/s)	*16 µW*	*18 µW*
Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)	*16 µW*	*18 µW*
32G Fibre Channel (28.05 Gb/s)	*16 µW*	*18 µW*
53.125 GBaud PAM4 TDECQ (26.6 GHz)	*18 µW*	*22 µW*
53.125 GBaud NRZ (39.8 GHz)	*30 µW*	*35 µW*
Unfiltered (60 GHz)	*35 µW*	*45 µW*
Unfiltered (65 GHz)	*80 µW*	*95 µW*
RMS Noise (Maximum)	**1310 nm**	**1550 nm**
25 Gb/s Ethernet (25.78125 Gb/s)	20 µW	25 µW
400GBASE-SR16 (26.5625 Gb/s)	20 µW	25 µW
Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)	20 µW	25 µW
32G Fibre Channel (28.05 Gb/s)	20 µW	25 µW
49.77 GBaud NRZ ITU-T G.hsp (PON)	40 µW	55 µW
53.125 GBaud PAM4 TDECQ (26.6 GHz)	30 µW	35 µW
53.125 GBaud NRZ (39.8 GHz)	40 µW	55 µW
Unfiltered (60 GHz)	50 µW	65 µW
Unfiltered (65 GHz)	105 µW	110 µW

Optical Sensitivity *(Characteristic)* [5]	1310 nm	1550 nm
25 Gb/s Ethernet (25.78125 Gb/s)	*–6.5 dBm*	*–6.0 dBm*
400GBASE-SR16 (26.5625 Gb/s)	*–6.5 dBm*	*–6.0 dBm*
Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)	*–6.5 dBm*	*–6.0 dBm*
32G Fibre Channel (28.05 Gb/s)	*–6.5 dBm*	*–6.0 dBm*

Scale Factor Specifications (per division, 8 divisions)	Description
Minimum	5 µW
Maximum	500 µW
CW Offset Range [6]	+1.0 mW to −3 mW
CW Accuracy (single mode)[7]	*± 15 µW ± 1.5% of reading ± connector uncertainty (Characteristic)* ± 30 µW ± 3% of reading ± connector uncertainty
Maximum Measureable Input Power	4 mW at 500 µW/division scale factor
Average Power Monitor Range	−30 dBm to +6 dBm (1310 nm) −30 dBm to +6 dBm (1550 nm)

Average Power Monitor Accuracy [8]	Description
For 1 µW ≤ P_{input} ≤ 2 mW	200 nW ± 5% of reading ± connector uncertainty
For 2 mW ≤ P_{input} ≤ 4 mW	200 nW ± 10% of reading − 100µW ± connector uncertainty
Maximum Non-destruct Peak Power	5 mW (+7 dBm)
Fiber Input	9/125 µm
Fiber Input Connector	FC
Channel ADC	16 bits

1. With the unfiltered setting selected, −3 dBo is calculated from the −6 dBe point.
2. Tuned to –3 dBo (± measurement uncertainty) at stated bandwidth(s).
3. For the average power monitor and the channel vertical path.
4. The frequency response is verified using an optical impulse (< 1 ps FWHM).
5. Generally represents the power level where an ideal eye diagram will approach 0% mask margin due to the noise of the oscilloscope. Provides a *non-specified* figure of merit to compare sensitivities of various optical channels. These values are calculated from the characteristic noise values.
6. Referenced two divisions from screen bottom.
7. Single marker, referenced to power sensor.
8. Average power monitor accuracy is tied to the calibration accuracy of the power sensor.

N1030A (Option EC1) electrical channel specifications

Item	Description
Electrical Channel Count	1
Electrical Input Connectors	1 mm (m) bulkhead
Bandwidth, −3 dB (user selectable)	33, 40, 50, 70, 85, and 95 GHz [1]
Transition Time (10% to 90% calculated from TR = 0.35/BW)	**Description**
33 GHz BW	*10.6 ps (Calculated)*
40 GHz BW	*8.8 ps (Calculated)*
50 GHz BW	*7.0 ps (Calculated)*
70 GHz BW	*5 ps (Calculated)*
85 GHz BW	*4.2 ps (Calculated)*
95 GHz BW	*3.7 ps (Calculated)*
RMS Noise *(Characteristic)*	**Description**
33 GHz BW	*350 µV (Characteristic)*
40 GHz BW	*350 µV (Characteristic)*
50 GHz BW	*450 µV (Characteristic)*
70 GHz BW	*650 µV (Characteristic)*
85 GHz BW	*950 µV (Characteristic)*
95 GHz BW	*1150 µV (Characteristic)*
RMS Noise (Maximum)	**Description**
33 GHz BW	450 µV
40 GHz BW	500 µV
50 GHz BW	600 µV
70 GHz BW	800 µV
85 GHz BW	1200 µV
95 GHz BW	1400 µV
Scale Factor (per division)	**Description**
Minimum	1 mV/division
Maximum	100 mV/division
DC Accuracy (V_{AVG} Measurement) (at 33, 40, 50, 70, 85, 95 GHz BWs) [2]	**Description**
Specification	± 2 mV ± 4% (reading − offset)
Characteristic	*± 2 mV*
DC Offset Range (referenced to center of screen)	± 500 mV
Input Dynamic Range (relative to channel offset)	± 400 mV
Maximum Input Signal	± 2V (+16 dBm)

Maximum Sample Rate	Description
When used in an N1000A mainframe	*250 kSa/s (Characteristic)*
When used in an 86100D mainframe	*40 kSa/s (Characteristic)*
Nominal Input Impedance	50 Ω

1. Tuned to be −3 dB (± measurement uncertainty) at stated bandwidth(s).
2. Specified at calibration temperature ± 0.5 °C. Perform a new module calibration if hardware skew has been applied.

N1032A/B module specifications



N1032A/B optical channel specifications

Item	Description	
Optical Channel Count	1 (N1032A) 2 (N1032B)	
Optical Channel Bandwidth, –3 dBo [1, 8]	**Option 09U**	**Option 13U**
BW (unfiltered)	60 GHz	60 GHz
	80 GHz	80 GHz
	90 GHz	90 GHz
		110 GHz
		120 GHz (characteristic)
Nominal Wavelength Range	1250 nm to 1625 nm	
Factory calibrated wavelengths [2]	1310 nm (± 20 nm) 1550 nm (± 20 nm)	
User calibration wavelength range	1250 nm to 1625 nm	
Hardware Reference Receiver Filters [3]	**Description (Option 112)**	
49.7664 GBd (37.3248 GHz, –3 dBe)	ITU-T PON	
106.25 GBd (53.125 GHz, –3 dBe)	IEEE 800GBASE TDECQ	
106.25 GBd (79.6875.25 GHz, –3 dBe)	NRZ Reference Filter	
112.5 GBd (56.25 GHz, –3 dBe)	4x200G-FR4 MSA Rev1	
RMS Noise *(Characteristic)* [7]	**1310 nm**	**1550 nm**
49.7664 GBd (37.3248 GHz, –3 dBe)	*40 µW*	*75 µW*
106.25 GBd (53.125 GHz, –3 dBe)	*60 µW*	*105 µW*
106.25 GBd (79.6875.25 GHz, –3 dBe)	*135 µW*	*235 µW*
112.5 GBd (56.25 GHz, –3 dBe)	*65 µW*	*110 µW*
Unfiltered 60 GHz (–3 dBo)	*45 µW*	*80 µW*
Unfiltered 80 GHz (–3 dBo)	*65 µW*	*120 µW*
Unfiltered 90 GHz (–3 dBo)	*90 µW*	*155 µW*
Unfiltered 110 GHz (–3 dBo)	*130 µW*	*235 µW*
Unfiltered 120 GHz (–3 dBo)	*175 µW*	*300 µW*

RMS Noise (Maximum) [7]	1310 nm	1550 nm
49.7664 GBd (37.3248 GHz, –3 dBe)	50 µW	85 µW
106.25 GBd (53.125 GHz, –3 dBe)	70 µW	120 µW
106.25 GBd (79.6875.25 GHz, –3 dBe)	145 µW	235 µW
112.5 GBd (56.25 GHz, –3 dBe)	75 µW	125 µW
Unfiltered 60 GHz (–3 dBo)	55 µW	90 µW
Unfiltered 80 GHz (–3 dBo)	80 µW	135 µW
Unfiltered 90 GHz (–3 dBo)	105 µW	165 µW
Unfiltered 110 GHz (–3 dBo)	150 µW	235 µW
Unfiltered 120 GHz (–3 dBo)	185 µW	315 µW

Scale Factor Specifications (per division, 8 divisions)	Description
Minimum	40 µW
Maximum	2 mW
CW Offset Range [4]	+4 mW to −12 mW
CW Accuracy (single mode, $P_{input} \leq 8$ mW)[5,7]	*±(50 µW + 2% of reading) ± connector uncertainty (1310 nm) (Characteristic)*
	±(300 µW + 4% of reading) ± connector uncertainty (1310 nm)
	±(100 µW + 3% of reading) ± connector uncertainty (1550 nm) (Characteristic)
	±(300 µW + 7% of reading) ± connector uncertainty (1550 nm)
Maximum Measurable Input Power	16 mW at 2 mW/division scale factor

Average Power Monitor Range	Description
1310 nm	−30 dBm to +9 dBm
1310 nm *(Characteristic)*	*−30 dBm to +12 dBm*
1550 nm	−30 dBm to +9 dBm
1550 nm *(Characteristic)*	*−30 dBm to +12 dBm*

Average Power Monitor Accuracy [6,7]	Description
For 1 µW ≤ P_{input} ≤ 8 mW	*±(200 nW + 2% of reading) ± connector uncertainty (1310 nm)*
	±(200 nW + 3% of reading) ± connector uncertainty (1550 nm)
For 50 µW ≤ P_{input} ≤ 8 mW	±(4% of reading) ± connector uncertainty (1310 nm)
	±(7% of reading) ± connector uncertainty (1550 nm)

Maximum Non-destruct Peak Power	18 mW (+12.5 dBm)
Fiber Input	9/125 µm
Fiber Input Connector	FC
Channel ADC	16 bits

N1032A/B Maximum Sampling Rate	Description
When used in an N1000A mainframe	*250 kSa/s (Characteristic)*
When used in an 86100D mainframe	*40 kSa/s (Characteristic)*

1. With the unfiltered setting selected, −3 dBo is calculated from the −6 dBe point.
2. For the average power monitor and the channel vertical path.
3. The frequency response is verified using a 1550 nm optical impulse (< 1 ps FWHM) at 25 ± 5 °C.
4. Referenced two divisions from screen bottom.
5. Single marker, does not include optical power meter uncertainty.
6. Average power monitor accuracy does not include optical power meter uncertainty.
7. When within ±5 °C of both the channel vertical calibration temperature and the channel optical calibration temperature. For optical channel calibration performed with 2 mW ± 0.1 mW at the specified wavelength.
8. Tuned to –3 dBo (± measurement uncertainty) at stated bandwidth(s).

N1040A module specifications



N1040A specifications

Item	Description	
Electrical Channel Count	2	
Electrical Input Connectors	2.92 mm (Option 033) 1.85 mm (Option 060)	
Bandwidth, 3 dB (user selectable) [1]	**Option 033**	**Option 060**
	20 GHz 33 GHz	20 GHz 33 GHz 40 GHz 60 GHz
Transition Time (10% to 90% calculated from TR = 0.35/BW)	**Option 033**	**Option 060**
20 GHz BW	*17.5 ps (Calculated)*	*17.5 ps (Calculated)*
33 GHz BW	*10.6 ps (Calculated)*	*10.6 ps (Calculated)*
40 GHz BW	—	*8.8 ps (Calculated)*
60 GHz BW	—	*5.8 ps (Calculated)*
Channel-to-Channel Skew Range	± 100 ps	
RMS Noise	**Option 033**	**Option 060**
20 GHz BW	*275 µV (Characteristic)*	*275 µV (Characteristic)*
33 GHz BW	*350 µV (Characteristic)*	*350 µV (Characteristic)*
40 GHz BW	—	*450 µV (Characteristic)*
60 GHz BW	—	*550 µV (Characteristic)*
RMS Noise (Maximum)	500 µV	800 µV
Scale Factor (per division)	**Description**	
Minimum	1 mV/division	
Maximum	100 mV/division	
DC Accuracy (V_{AVG} Measurement) (at 20, 33, 40, 60 GHz BWs)[2]	**Description**	
Specification	± 2 mV ± 4% of (reading – channel offset)	
Characteristic	*± 1.15 mV*	
DC Offset Range (referenced to center of screen)	± 500 mV	
Input Dynamic Range (relative to channel offset)	± 400 mV	
Maximum Input Signal	± 2V (+16 dBm)	
Maximum Sample Rate	**Description**	
When used in an 86100D mainframe	*40 kSa/s (Characteristic)*	
When used in an N1000A mainframe	*250 kSa/s (Characteristic)*	

Nominal Input Impedance	50 Ω
Reflections (for 30 ps rise time)	*20% (Characteristic)*

1. Tuned to be –3 dB (± measurement uncertainty) at stated bandwidths.
2. Specified at calibration temperature ± 0.5 °C. Perform a new module calibration if hardware skew has been applied.

N1045B module specifications



N1045B specifications

Item	Description
Electrical Input Channels (per option)	**Description**
02F	2 Channel Remote Head with 1.85 mm (f) connectors.
02M	2 Channel Remote Head with 1.85 mm (m) connectors.
04F	4 Channel Remote Head with 1.85 mm (f) connectors.
04M	4 Channel Remote Head with 1.85 mm (m) connectors.
Remote Head Cable Length	The nominal length of the remote head cables is 1270 mm as measured from the module's front panel to the remote head's casing.
Bandwidth, 3 dB (user selectable)	*20 GHz (Characteristic)* *35 GHz (Characteristic)* *45 GHz (Characteristic)* 60 GHz
Transition Time (10% to 90% calculated from TR = 0.35/BW)	**Description**
20 GHz BW	*17.5 ps (Calculated)*
35 GHz BW	*10 ps (Calculated)*
45 GHz BW	*7.8 ps (Calculated)*
60 GHz BW	*5.8 ps (Calculated)*
Channel-to-Channel Skew Range	± 100 ps
RMS Noise	**Description**
20 GHz BW	*310 µV (Characteristic)*
35 GHz BW	*450 µV (Characteristic)*
45 GHz BW	*530 µV (Characteristic)*
60 GHz BW	*875 µV (Characteristic)*
RMS Noise *(Maximum)*	975 µV (60 GHz BW setting)
Scale Factor (per division)	**Description**
Minimum	1 mV/division
Maximum	100 mV/division
DC Accuracy (V_{AVG} Measurement) [1]	**Description**
20, 35, 45, 60 GHz	*± 1.15 mV (Characteristic)*
DC Accuracy (V_{AVG} Measurement) [2]	**Description**
20, 35, 45, 60 GHz	± 2 mV ± 4% of (reading – channel offset)
DC Offset Range (referenced to center of screen)	± 500 mV
Input Dynamic Range (relative to channel offset)	± 400 mV

Maximum Input Signal	± 2 V (+16 dBm)
Maximum Sample Rate	*250 kSa/s (when used in N1000A Mainframe, Characteristic)* *40 kSa/s (when used in 86100D Mainframe, Characteristic)*
Nominal Input Impedance	*50 Ω (Characteristic)*
Reflections (for 30 ps rise time)	*20% (Characteristic)*

1. Specified at calibration temperature ± 0.5 °C. (Perform a new module calibration if hardware skew has been applied.)
2. Specified at calibration temperature ± 5 °C.

Input Impedance (Graph of S11) , *Characteristic*

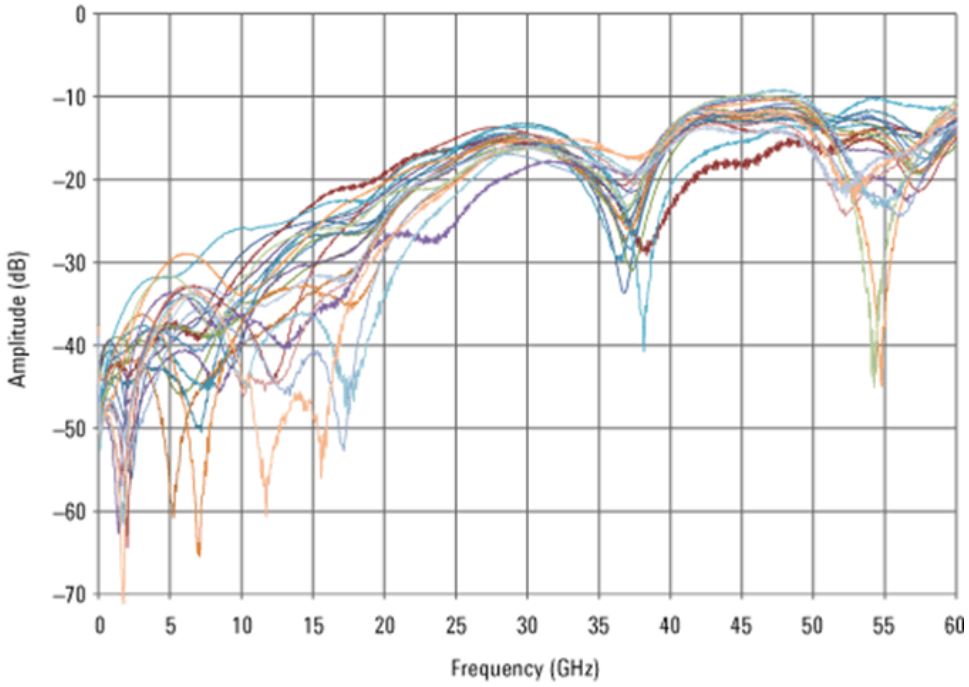


Figure 1. Graph of S11 *(characteristic)*

N1046A module specifications



N1046A maximum BW (1 Channel) per option specifications

Option	75 GHz	85 GHz	100 GHz
71F	•		
81F		•	
11F			•

N1046A maximum BW (2 Channel) per option specifications

Option	75 GHz	85 GHz	100 GHz
72F	•		
82F		•	
12F			•

N1046A maximum BW (4 Channel) per option specifications

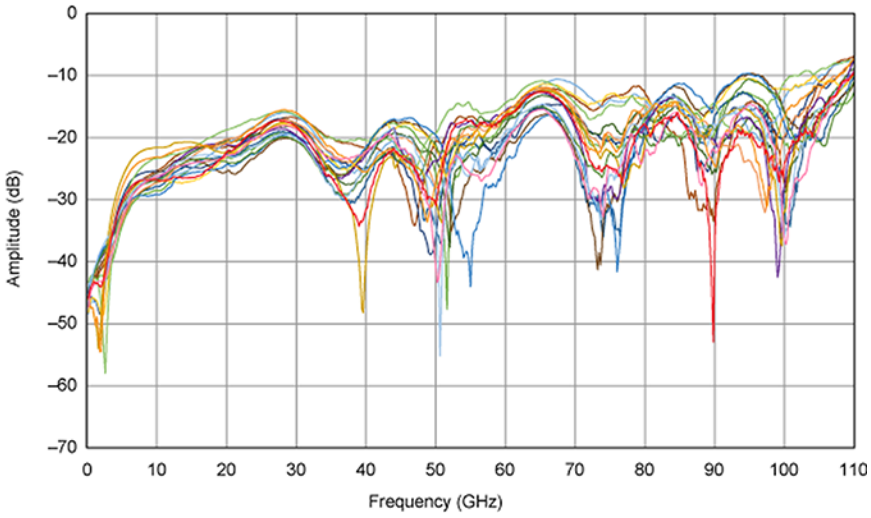
Option	75 GHz	85 GHz	100 GHz
74F	•		
84F		•	
14F			•

N1046A specifications

Item	Description		
Bandwidth[1], 3 dB (user selectable)	**Options 71F, 72F, and 74F**	**Options 81F, 82F, and 84F**	**Options 11F, 12F, and 14F**
45 GHz	•	•	•
60 GHz	•	•	•
75 GHz	•	•	•
85 GHz		•	•
100 GHz			•
122 GHz (Characteristic)			•
Transition Time (10% to 90% calculated from t_r = 0.35/BW)	**Options 71F, 72F, and 74F**	**Options 81F, 82F, and 84F**	**Options 11F, 12F, and 14F**
45 GHz	7.8 ps	7.8 ps	7.8 ps
60 GHz	5.9 ps	5.9 ps	5.9 ps
75 GHz	4.7 ps	4.7 ps	4.7 ps
85 GHz	—	4.2 ps	4.2 ps
100 GHz	—	—	3.5 ps
122 GHz (Characteristic)	—	—	< 3.2 ps
Channel-to-Channel Skew Range	± 100 ps		
RMS Noise	**Options 71F, 72F, and 74F**	**Options 81F, 82F, and 84F**	**Options 11F, 12F, and 14F**
45 GHz	600 µV *440 µV (Characteristic)*	600 µV *440 µV (Characteristic)*	600 µV *440 µV (Characteristic)*
60 GHz	750 µV *580 µV (Characteristic)*	750 µV *580 µV (Characteristic)*	750 µV *580 µV (Characteristic)*
75 GHz	1 mV *780 µV (Characteristic)*	1 mV *780 µV (Characteristic)*	1 mV *780 µV (Characteristic)*
85 GHz	—	1200 µV *900 µV (Characteristic)*	1200 µV *900 µV (Characteristic)*
100 GHz	—	—	1400 µV *1050 µV (Characteristic)*
122 GHz (Characteristic)	—	—	*2000 µV (Characteristic)*
Scale Factor (per division)	**Description**		
Minimum	1 mV/division		
Maximum	100 mV/division		
DC Accuracy (V_{AVG} Measurement)	**Description**		
Specified at calibration temperature ± 0.5 °C. (Perform a new module calibration if hardware skew has been applied.)	*± 2 mV (Characteristic)*		
Specified at calibration temperature ± 5 °C.	± 2 mV ± 4% of (reading – channel offset)		
DC Offset Range (referenced to center of screen)	± 500 mV		
Input Dynamic Range (relative to channel offset)	± 400 mV		

Maximum Input Signal	± 2 V (+16 dBm)
Maximum Sample Rate	*When used in an 86100D mainframe: 40 kSa/s (Characteristic).* *When used in an N1000A mainframe: 250 kSa/s (Characteristic)*
Nominal Input Impedance	*50 Ω (Characteristic)*
Remote Head Cable Length	The nominal length of the remote head cables is 1270 mm as measured from the module's front panel to the remote head's casing.

Input Impedance. Graph of S11 *(Characteristic)*



1. Tuned to be –3 dB (± measurement uncertainty) at stated bandwidth(s), except for 122 GHz which is tuned for highest bandwidth while keeping channel noise ≤ 2.5 mV RMS.

N1055A module specifications



N1055A general specifications

Item	Module Options[1] N1055A-32F N1055A-32M	Module Options[1] N1055A-34F N1055A-34M	Module Options[1] N1055A-52F N1055A-52M	Module Options[1] N1055A-54F N1055A-54M
Number of Channels	2 [2]	4	2 [2]	4
Remote Head Cable Length	The nominal length of the remote head cables is 1270 mm as measured from the module's front panel to the remote head's casing.			
Electrical Input [3]	2.92 mm (female or male)		1.85 mm (female or male)	
Electrical Channel Bandwidth	35 GHz [4, 5]		35 GHz or 50 GHz [5]	
Receiver Transition Time (10% to 90% calculated from T_R = 0.35/BW)	*10 ps, characteristic*		*10 ps (35 GHz BW setting), characteristic* *7 ps (50 GHz BW setting), characteristic*	
Channel-to-Channel Skew Range	± 150 ps			
Vertical Resolution	16 bit A/D converter			
RMS Noise	*600 µV, characteristic* 730 µV, maximum		*600 µV (35 GHz BW setting), characteristic* *750 µV (50 GHz BW setting), characteristic* 950 µV (50 GHz BW setting), maximum	
Scale Factor (Per Division)	**Description**			
Minimum	1 mV / division			
Maximum	100 mV / division			
DC Accuracy (V_{AVG} Measurement)	*± 800 uV, characteristic* Specified at calibration temperature ± 0.5 °C. (Perform a new module calibration if hardware skew has been applied.)			
	± 2 mV ± 4% of (reading–channel offset) Specified at calibration temperature ± 10 °C			
DC Offset Range (referenced from center of screen)	± 500 mV			
Input Dynamic Range (relative to channel offset)	± 400 mV			
Maximum Input Signal	+2 V / –1 V			
Nominal Impedance	50 ohm			
Maximum Sample Rate, module timebase [6]	**Description**			
Option-FS1	*250 kSa/s, characteristic*			
Standard	*80 kSa/s, characteristic*			

TDR Step Repetition Rate [6]	Description
Mainframe Timebase	*1 kHz to 250 kHz, characteristic*
Module timebase (standard)	*1 kHz to 80 kHz, characteristic*
Module timebase (Option FS1)	*1 kHz to 250 kHz, characteristic*

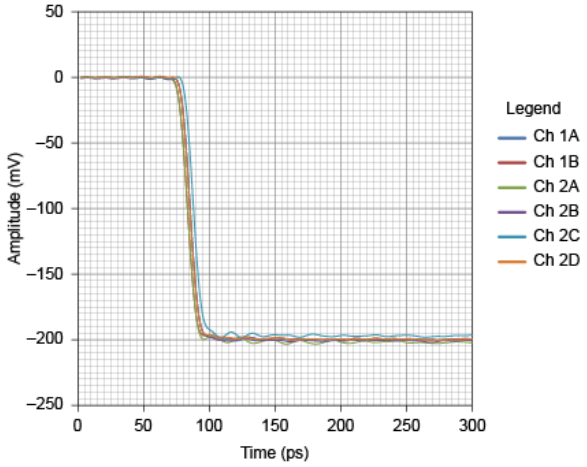
1. Connectors: F = female, M = male.
2. Upgradable from 2 channel to 4 channel after purchase (return to Keysight).
3. Connector style is the same on all channels and is selected at time of order.
4. Upgradable from 35 GHz to 50 GHz after purchase (return to Keysight).
5. Tuned to be –3 dB (± measurement uncertainty) at stated bandwidth(s) using NIST traceable swept-sine test system.
6. FlexDCA software auto-selects the mainframe or module timebase dependent on the DUT setup. In cases where the mainframe timebase is used, the maximum sample rate will be:
   86100D Mainframe: 40 kSa/s for standard modules and modules with option-FS1, *(characteristic)*.
   N1000A Mainframe: 80 kSa/s for standard modules and 250 kSa/s for modules with option-FS1, *(characteristic)*.

TDR system specifications

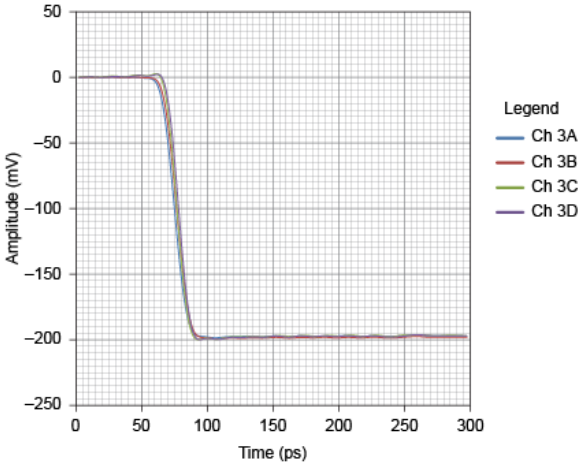
Item	Module Options[1] N1055A-32F N1055A-32M N1055A-34F N1055A-34M	Module Options[1] N1055A-52F N1055A-52M N1055A-54F N1055A-54M
Incident TDR Step Transition Time (10 % to 90 %) [2, 3]	**Description**	
Without TDR Calibration	< 18 ps	< 7 ps
With TDR Calibration	*Adjustable from 15 ps, characteristic*	*Adjustable from 6 ps, characteristic*
Reflected TDR Step Transition Time (10% to 90%) [3]	**Description**	
Without TDR Calibration	< 20 ps	< 11 ps
With TDR Calibration	< 18 ps	*9.5 ps, characteristic*
TDR Step Amplitude (Combined Oscilloscope and TDR Performance)	100 mV Setting: 0 mV to ± 100 mV 200 mV Setting: 0 mV to ± 200 mV	100 mV Setting: 0 mV to ± 100 mV 200 mV Setting: 0 mV to ± 200 mV

1. Connectors: F = female, M = male.
2. Incident TDR edge speed is defined as the transition time at the output of the remote head. It is calculated by de-convolving the receiver transition time from the measured transition time when the remote head is terminated with a short.
3. Measured on a negative TDR step, terminated in a short.

Step flatness (graphs of combined oscilloscope and TDR performance)

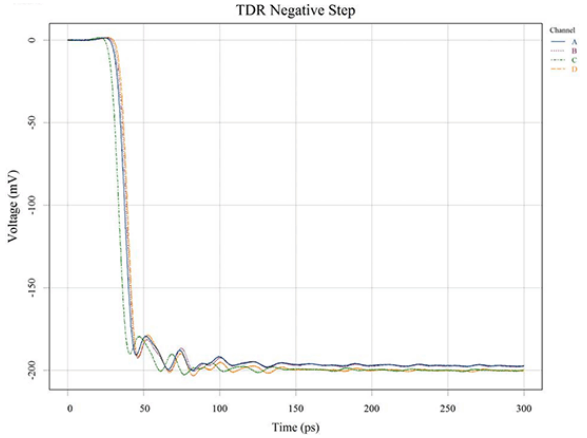


Options 52F, 52M, 54F, and 54M with TDR Calibration (Characteristic)

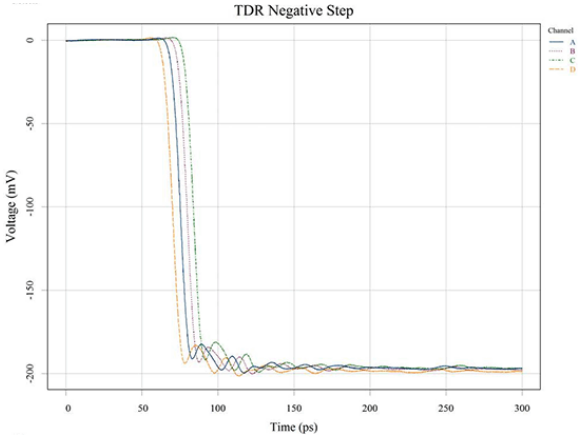


Options 32F, 32M, 34F, and 34M with TDR Calibration (Characteristic)

In the following two graphs, the blue trace shows Channel A, the red trace shows Channel B, The green trace shows Channel C, and the yellow trace shows Channel D.



Options 52F, 52M, 54F, and 54M without TDR Calibration (Characteristic)

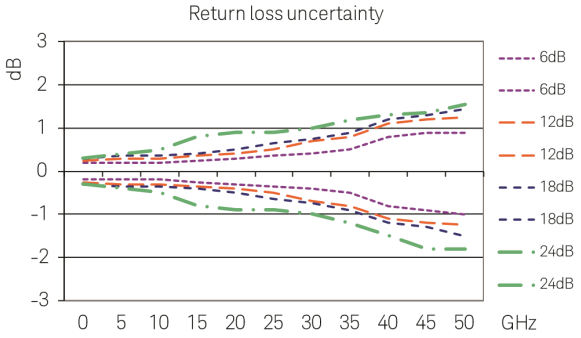


Options 32F, 32M, 34F, and 34M without TDR Calibration (Characteristic)

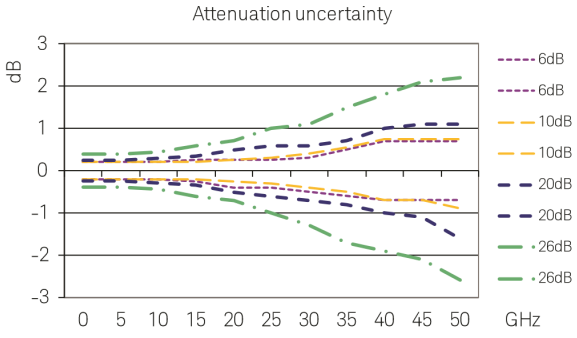
N1055A performance characteristics

Apply when N1055A used with N1010300A Signal Integrity Package for FlexDCA Sampling Oscilloscope Software. Test conditions:

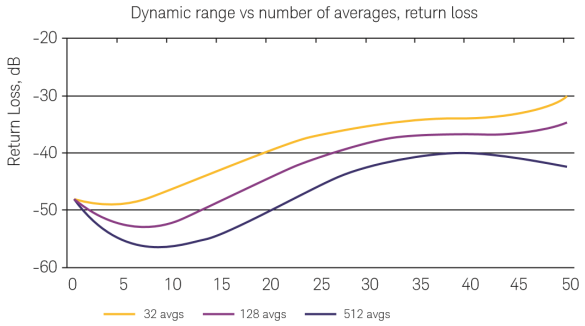
- Mainframe and module have been turned on for at least one hour and have been calibrated
- TDR calibration has been performed using appropriate electronic or mechanical calibration units
- Derived from measurements made on 1.85 mm verification devices that were calibrated by Keysight metrology lab
- Averages of 512 except as noted in dynamic range



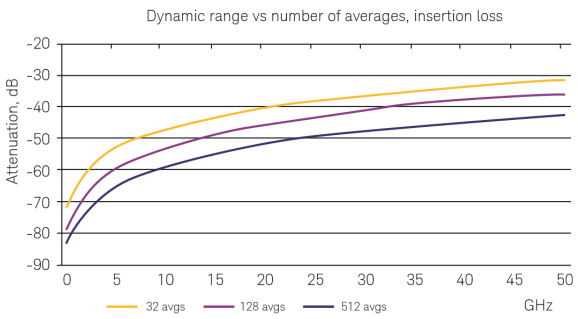
Return Loss Uncertainty (Characteristic)



Attenuation Uncertainty (Characteristic)



Dynamic Range vs Number of Averages, Return Loss (Characteristic)



Dynamic Range vs Number of Averages, Insertion Loss (Characteristic)

N1060A module specifications



N1060A general specifications

Item	Option 050	Option 085
Bandwidth [1], 3 dB (user selectable)	50 GHz	50 GHz, 70 GHz, 85 GHz, and *95 GHz (characteristic)*
Risetime (10% to 90%, calculated from TR = 0.35/BW)	*7 ps (characteristic)*	*4 ps (characteristic)*
RMS noise	**Description**	
Characteristic	*0.7 mV (50 GHz)*	*0.7 mV (50 GHz)* *1.1 mV (75 GHz)* *1.2 mV (85 GHz)* *1.6 mV (95 GHz)*
Maximum	1 mV (50 GHz)	1 mV (50 GHz) 1.3 mV (75 GHz) 1.6 mV (85 GHz) 2.0 mV (95 GHz)
Scale Factor (per division)	**Description**	
Minimum	1 mV/division	
Maximum	140 mV/division	
DC Accuracy (V_{AVG} Measurement)	**Description**	
Specified at calibration temperature ± 0.5 °C. (Perform a new module calibration if hardware skew has been applied.)	*± 2 mV (Characteristic)*	
Specified at calibration temperature ± 5 °C.	± 2 mV ± 4% of (reading - channel offset)	
DC offset range (referenced from center of screen)	± 560 mV	
Input dynamic range (relative to channel offset)	± 560 mV	
Maximum input signal	± 1V (+10 dBm)	

Random Jitter (clock recovery without precision timebase active)	Description
N1000A-LOJ	*< 200 fs (characteristic) at 10.3 GHz, 26.56 GHz.*
N1000A-STD	*< 400 fs (characteristic) at 10.3 GHz, 26.56 GHz.*
Random jitter (clock recovery and precision timebase configuration) [2]	< 80 fs (≥ 10 GHz) *45 fs (characteristic) at 26.56 GHz* *60 fs (characteristic) at 10.3 GHz*
Random jitter (external trigger signal applied to precision timebase input) [3]	< 80 fs (≥ 10 GHz) *45 fs (characteristic) at 26.56 GHz* *60 fs (characteristic) at 10.3 GHz*
Precision timebase reference input frequency range	2.4 to 32 GHz
Precision timebase reference input amplitude (recommended for optimal jitter performance)	*1.0 to 1.6 Vpp (characteristic)*
Precision timebase input signal type (The precision timebase performs optimally with a sinusoidal input. Non-sinusoidal signals will operate with some degradation in timebase linearity.)	Sinusoid
Precision timebase maximum input level	± 2 V (16 dBm)
Precision timebase nominal input impedance	50 ohm
Precision timebase connector type	2.92 mm male
Channel nominal impedance	*50 ohm*
Electrical Input	1 mm (male) [4]
Channel-to-channel skew range	± 100 ps
Effective trigger-to-sample delay (clock recovery and precision timebase configuration)	*< 350 ps (characteristic)*

1. Tuned to be –3 dB (± measurement uncertainty) at stated bandwidths, except for 95 GHz which is tuned for highest bandwidth while keeping channel noise ≤ 2 mV RMS.
2. Verified with input signal 1 Vpp @ 10 GHz and 26.56 GHz with 50 GHz channel BW.
3. Verified with input signal 1 Vpp @ 10 GHz, 0.8 Vpp @ 26.56 GHz with 50 GHz channel BW, ~1 Vpp to PTB input.
4. Ships with ruggedized 1.0 mm (f) to 1.85 mm (f) adaptors.

Input impedance specifictions

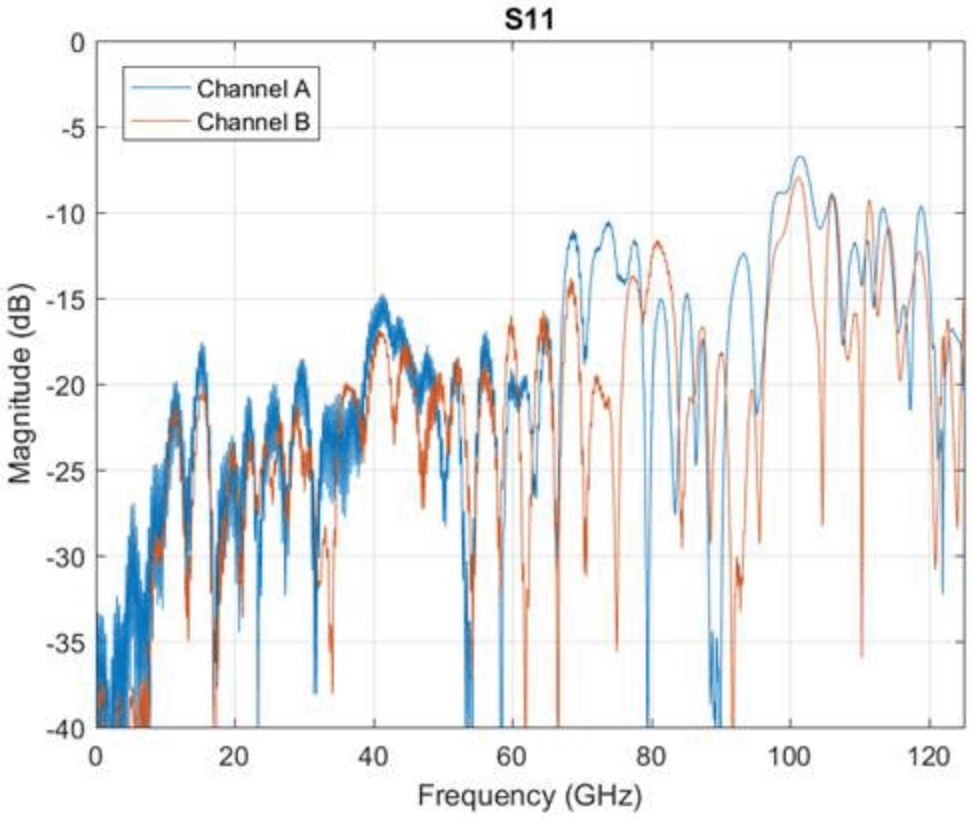


Figure 2. Graph of S11 *(characteristic)*

N1060A clock recovery specifications

Item	Option 216	Option 232	Option 264
Data rates input range	125 MBd to 16 GBd *125 MBd to 16.4 GBd (characteristic)*	125 MBd to 32 GBd *125 MBd to 32.8 GBd (characteristic)*	125 MBd to 64 GBd *125 MBd to 65.8 GBd (characteristic)*
Clock frequency input range	62.5 MHz to 8 GHz *62.5 MHz to 8.2 GHz (characteristic)*	62.5 MHz to 16 GHz *62.5 MHz to 16.4 GHz (characteristic)*	62.5 MHz to 32 GHz *62.5 MHz to 32.8 GHz (characteristic)*
Minimum input level to acquire lock (NRZ and PAM4, single-ended, open eye)	100 mVpp *30 mVpp at 10.3125 GBd (characteristic)*	100 mVpp *30 mVpp at 10.3125 GBd (characteristic)* *30 mVpp at 26.56 GBd (characteristic)*	100 mVpp (rate ≤ 53.125 GBd) 200 mVpp (rate > 53.125 GBd) *30 mVpp at 10.3125 GBd (characteristic)* *30 mVpp at 26.56 GBd (characteristic)* *60 mVpp at 53.125 GBd (characteristic)* *60 mVpp at 56 GBd (characteristic)* *100 mVpp at 64 GBd (characteristic)*
Minimum input level to acquire lock (PAM4, single-ended, closed eye)	N/A	*200 mVpp at 26.56 GBd with 20 dB channel loss at 13.28 GHz (characteristic)*	*200 mVpp at 26.56 GBd with 20 dB channel loss at 13.28 GHz (characteristic)* *200 mVpp at 53.125 GBd with 16 dB channel loss at 26.56 GHz (characteristic)*
Recovered clock random jitter [1]	300 fs maximum ≥ 2.5 GHz *120 fs at 10.3 GHz (characteristic)*	300 fs maximum ≥ 2.5 GHz *80 fs at 26.56 GHz (characteristic)* *120 fs at 10.3 GHz (characteristic)*	
Clock recovery adjustable loop bandwidth range (user selectable)	0.015 to 20 MHz (depends on Baud Rate)		
Clock recovery loop peaking range	Up to 4 settings (dependent on loop BW)		
Loop bandwidth accuracy [2, 3]	*± 30%, (characteristic, NRZ)*		
Tracking range (includes spread-spectrum tracking)	*± 2500 ppm (± 0.25%), (characteristic, NRZ)*		

Acquisition range	Description
Standard signals:	*± 300 ppm, (characteristic)*
Spread spectrum signals:	*± 5000 ppm, (characteristic, NRZ)*
Maximum consecutive identical digits to lock	*150 (characteristic)*
Auto relocking	Yes (user enabled)

Jitter Spectrum Analysis (Option JSA)	Description		
Phase noise accuracy	*± 30% (characteristic, NRZ)*		
Clock Recovery Emulation (CRE) Operating Range (Valid for open-eye signals)	*1 — 58 GBd (NRZ) (characteristic)*		
	1 — 31 GBd (PAM4) (characteristic)		
Front panel recovered clock amplitude	≥ 200 mVpp *450 mV at 5 GHz (characteristic)*	≥ 200 mVpp *450 mV at 5 GHz (characteristic)* *275 mV at 26.56 GHz (characteristic)*	≥ 200 mVpp *450 mV at 5 GHz (characteristic)* *275 mV at 26.56 GHz (characteristic)*
Front panel recovered clock divide ratio (user selectable)	1, 2, 4, 8, 16, 32		
Recovered clock front panel connector type	2.92 mm (m)		
Internal frequency counter accuracy	± 10 ppm *4 ppm (characteristic)*		

1. Verified by connecting a sinewave to N1060A Channel A, then measuring Recovered Clock signal connected to Channel B (PTB enabled).
2. PLL bandwidth is calibrated and verified using a clean NRZ, PRBS13 signal.
3. Actual PLL bandwidth may vary due to several factors, including pattern characteristics (low/high transition density), signaling format (PAM4), and signal quality (closed eyes).

Modules no longer available but supported by the N1000A DCA-X Mainframe

- N1045A 60 GHz Electrical
- 54752A 50 GHz Dual Channel Electrical
- 54754A Differential TDR/TDT
- 83484A Dual Channel 50 GHz Electrical
- 83496A Optical/Electrical Clock Recovery, 50 Mb/s-7.1 Gb/s
- 83496B Optical/Electrical Clock Recovery with Phase Noise Analysis
- 86112A Dual Channel 20 GHz Electrical
- 86105C Optical/Electrical Channel
- 86105D Optical/Electrical Channel
- 86107A Precision Timebase Reference
- 86108A Precision Waveform Analyzer
- 86108B Precision Waveform Analyzer
- 86115D Dual Channel Optical
- 86116C Optical/Electrical Channel
- 86117A 50 GHz Dual Channel Electrical
- 86118A Dual 70 GHz remote sampling head

Ordering Information

The following tables offer helpful information about the DCA-X software, mainframe and plug-in modules and their options but are not intended to serve as a configuration guide.

When configuring a solution, please also refer to the following helpful documents:

- Keysight DCA Wide-Bandwidth Oscilloscope Family Configuration Guide (5992-3372EN)
- Keysight DCA Family FlexDCA Sampling Oscilloscope Software Technical Overview (5992-3319EN)
- Keysight DCA Family Clock Data Recovery Solutions Data Sheet (5992-1620EN)

N1000A DCA-X

N1000A DCA-X hardware options

Model/Option Number	Description
N1000A	Infiniium DCA-X mainframe
N1000A-PLK	Pattern Lock
N1000A-STB	Standard timebase
N1000A-LOJ	Low jitter timebase
N1000A-PTB	Precision timebase integrated in the mainframe
N1000A-GPI	GPIB card installed (mandatory option)

N1000A miscellaneous options

Model/Option Number	Description
N1027A-AFP	Module slot filler panel
1CM015A	Rack mount flange kit
1CP020A	Rack mount flange kit with handles
N1000A-UK6	Commercial calibration certificate with test data

N1000A DCA-X hardware upgrade options (if you already own an N1000A)

Model/Option Number	Description
N1000AU-PLK	Add Pattern Lock
N1000AU-LOJ	Add low jitter timebase
N1000AU-PTB	Add precision timebase integrated in the mainframe

FlexDCA software packages

Model Number	Description
N1010100A	Research and Development Package for FlexDCA
N1010200A	Manufacturing Package for FlexDCA
N1010300A	Signal Integrity Package for FlexDCA

N1002A DCA-M Optimization Controller

N1002A Hardware options

Model/Option Number	Description
N1002A	DCA-M Optimization Controller
N1002A-S00	No Integrated Switch (Controller Only)
N1002A-USB	Standard Universal Serial Bus Interface

N1002A miscellaneous options

Model/Option Number	Description
N1002A-AX4 (1CM110A)	Rack mount flange kit
N1002A-AXE (1CP104A)	Rack mount flange kit with handles
1CN106A	Handle kit

Software Licenses

Model	Description
N1010100A	R&D package for FlexDCA
N1010200A	Manufacturing package for FlexDCA
N1002L31A	FlexOTO Optical Test Optimization Dual 1x4 Bundle
N1002L33A	FlexOTO Optical Test Optimization 1x16 Bundle
N1002000A	FlexOTO Software for Basic Optimization
N1002014A	FlexOTO Software for up to 17 ports
N1002048A	FlexOTO Software for up to 48 ports
N1002128A	FlexOTO Software for up to 128 ports

Application software

See the application software datasheet to confirm hardware requirements.

SW Application Model	SW Application Description
N109228CA	Electrical TX Test SW for OIF-CEI-3.1
N109310CA	Electrical TX Test SW for SFF-8431 (SFP+)
D9010UDAA	User Defined Application Software (for DCA-X and RT Scopes)
N1091APCA	Electrical TX Test SW for IEEE 802.3ap (10G/40G)
N1091BMCA	Electrical TX Test SW for IEEE 802.3bm
N1091BACA	Electrical TX Test SW for IEEE 802.3ba (40G/100G)
N1091BJCA	Electrical TX Test SW for IEEE 802.3bj (100G)
N1091BSCB	Electrical TX Test SW for IEEE 802.3bs/cd
N1091CKCA	Electrical TX Test SW for IEEE 802.3ck
N109212CA	Electrical TX Test SW for OIF-CEI-112G
N109256CB	Electrical TX Test SW for OIF-CEI-4.0
N1095BSCA	Optical TX Test SW for IEEE 802.3bs/cd/cu
N1094BS1A	PAM4 Measurement Software Development Kit.
N1081PLCA	PLL Test Software for PCI Express.

Optical/electrical modules

Module/Option	Description
N1030A	Single 65 GHz optical channel, 9/125 µm fiber input
N1030A-280	Hardware filters for 25-28 NRZ Gbaud rates
N1030A-490	Hardware filter for 49.77 NRZ Gbaud ITU-T G.hsp (PON) rate
N1030A-560	Hardware filters for 53-56 Gbaud rates
N1030A-65U	65 GHz unamplified optical channel
N1030A-EC1	Add 95 GHz single electrical channel
N1030A-IRC	Impulse response correction (optical and electrical channels)
N1030B	Two 65 GHz optical channels, 9/125 µm fiber input
N1030B-280	Hardware filters for 25-28 NRZ Gbaud rates
N1030B-490	Hardware filter for 49.77 NRZ Gbaud ITU-T G.hsp (PON) rate
N1030B-560	Hardware filters for 53-56 Gbaud rates
N1030B-65U	65 GHz unamplified optical channel
N1030B-IRC	Impulse response correction
N1032A	Single 120 GHz optical channel, 9/125 µm fiber input
N1032A-09U	90 GHz unamplified optical channel
N1032A-13U	120 GHz unamplified optical channel
N1032A-112	Hardware filters for standards based rates
N1032A-IRC	Impulse response correction
N1032B	Two 120 GHz optical channels, 9/125 µm fiber input
N1032B-09U	90 GHz unamplified optical channel
N1032B-13U	120 GHz unamplified optical channel
N1032B-112	Hardware filters for standards based rates
N1032B-IRC	Impulse response correction

Dual/quad electrical channel modules

Module/Option	Description
N1040A-033	Two 33 GHz electrical channels
N1040A-060	Two 60 GHz electrical channels
N1045B	2/4 port 60 GHz electrical remote head
N1045B-02F	2 channel remote head, 1.85 mm, female
N1045B-02M	2 channel remote head, 1.85 mm, male
N1045B-04F	4 channel remote head, 1.85 mm, female
N1045B-04M	4 channel remote head, 1.85 mm, male
N1046A	100 GHz, 1/2/4 port electrical remote sampling head
N1046A-71F	1 channel, 75 GHz remote head, 1 mm, female
N1046A-81F	1 channel, 85 GHz remote head, 1 mm, female
N1046A-11F	1 channel, 100 GHz remote head, 1 mm, female
N1046A-72F	2 channel, 75 GHz remote head, 1 mm, female
N1046A-82F	2 channel, 85 GHz remote head, 1 mm, female
N1046A-12F	2 channel, 100 GHz remote head, 1 mm, female
N1046A-74F	4 channel, 75 GHz remote head, 1 mm, female
N1046A-84F	4 channel, 85 GHz remote head, 1 mm, female
N1046A-14F	4 channel, 100 GHz remote head, 1 mm, female

TDR/TDT modules

Module/Option	Description
N1055A [1]	35/50 GHz, 2/4 port, TDR/TDT remote head
N1055A-FS1	Fast sampling, mandatory option
N1055A-32F	35 GHz, 2 channel remote head, 2.92 mm, female
N1055A-32M	35 GHz, 2 channel remote head, 2.92 mm, male
N1055A-34F	35 GHz, 4 channel remote head, 2.92 mm, female
N1055A-34M	35 GHz, 4 channel remote head, 2.92 mm, male
N1055A-52F	50 GHz, 2 channel remote head, 1.85 mm, female
N1055A-52M	50 GHz, 2 channel remote head, 1.85 mm, male
N1055A-54F	50 GHz, 4 channel remote head, 1.85 mm, female
N1055A-54M	50 GHz, 4 channel remote head, 1.85 mm, male

1. When used in an 86100D, 86100D option ETR is recommended if more than one TDR module is connected to the same DUT

Precision waveform analyzer modules

Module/Option	Description
N1060A-050 [1]	Dual 50 GHz electrical channels
N1060A-085 [1]	Dual 85 GHz electrical channels
N1060A-216	Clock recovery 125 MBd to 16 GBd
N1060A-232	Clock recovery 125 MBd to 32 GBd
N1060A-264	Clock recovery 125 MBd to 64 GBd
N1060A-PTB	Integrated precision timebase (mandatory option [2])
N1060A-E33	Integrated hardware filters for 33 GHz, 40 GHz, and 43 GHz
N1060A-EVA	Integrated variable equalizers in clock path (mandatory option [2])
N1060A-JSA	Jitter Spectrum Analysis (mandatory option [2])
N1060A-A1F	Two 1 mm (f) to 1 mm (f) adapters
N1060A-A1M	Two 1 mm (m) to 1 mm (m) adapters
N1060A-A1X	Two 1 mm (m) to 1 mm (f) adapters
N1060A-CA1	Cable pair, 1 mm (m) to 1 mm (f), 160 mm length
N1060A-CA2	Matched cable pair, 2.4 mm (m) to 2.4 mm (m), 24 inch length
N1060A-DC2	Two DC blocks, 2.4 mm connectors, 16V, 50 kHz to 50 GHz
N1060AU-085	Upgrade to Option 085 Performance
N1060AU-264	Upgrade to Option 264
N1060AU-232	Upgrade to Option 232

1. 86100D option ETR recommended when used in an 86100D mainframe, N1000A option PLK recommended when used in an N1000A mainframe
2. Mandatory options are automatically provided with the product and cannot be unselected.

External clock recovery solutions

N1076B electrical clock recovery

Module/Option	Description
N1076B-216	Clock recovery range: 125 MBd to 16 GBd
N1076B-232	Clock recovery range: 125 MBd to 32 GBd
N1076B-264	Clock recovery range: 125 MBd to 64 GBd (56 GBd for PAM4 signals)
N1076B-EVA	Integrated variable equalizers (mandatory option [1])
N1076B-JSA	Jitter Spectrum Analysis

N1077A optical/electrical clock recovery

Module/Option	Description
N1077A-216	Clock recovery range: 50 MBd to 16 GBd
N1077A-232	Clock recovery range: 50 MBd to 32 GBd
N1077A-SMS	Internal SM and MM splitters
N1077A-SXT	No supplied splitter (standard option). External splitter must be supplied by user.
N1077A-JSA	Jitter spectrum analysis

N1077B optical/electrical clock recovery

Module/Option	Description
N1077B-216	Clock recovery range: 125 MBd to 16 GBd
N1077B-225	Clock recovery range: 24 to 29 GBd
N1077B-232	Clock recovery range: 125 MBd to 32 GBd
N1077B-253	Clock recovery range: 48 to 58 GBd
N1077B-264	Clock recovery range: 125 MBd to 64 GBd
N1077B-SMM	Internal 70/30 multimode optical splitter
N1077B-SXT	No supplied splitter (standard option). External splitter must be supplied by user
N1077B-EVA	Integrated variable equalizers in electrical input path (mandatory option [1])
N1077B-JSA	Jitter spectrum analysis

N1078A optical/electrical clock recovery

Module/Option	Description
N1078A-216	Clock recovery range: 125 MBd to 16 GBd
N1078A-225	Clock recovery range: 25 to 29 GBd
N1078A-232	Clock recovery range: 125 MBd to 32 GBd
N1078A-253	Clock recovery range: 53 to 58 GBd
N1078A-264	Clock recovery range: 125 MBd to 64 GBd
N1078A-S50	Internal 50-50 SM optical splitter
N1078A-SXT	No supplied splitter (standard option). External splitter must be supplied by user.
N1078A-JSA	Jitter spectrum analysis
N1078A-EVA	Integrated variable equalizers in electrical input path (mandatory option [1])

1. Mandatory options are automatically provided with the product and cannot be unselected.

Warranty Options (for All Products)

Warranty	Description
R1280A	Customer return repair service
R1282A	Customer return calibration service

Accessories

See the *DCA Accessories Guide* for available accessories (5991-2340EN).

Connectivity Solutions

For a wide range of test adapters to connect to one or more lanes for SFP+, QSFP+, fibre channel, PCIe and many others, please see adapters information from Wilder Technologies at: http://www.wilder-tech.com/. Call Keysight for connectivity and probing solutions not listed above.

Confidently Covered by Keysight Services

Prevent delays caused by technical questions, or system downtime due to instrument maintenance and repairs with Keysight Services. Keysight Services are here to support your test needs with expert technical support, instrument repair and calibration, software support, training, alternative acquisition program options, and more.

A KeysightCare agreement provides dedicated, proactive support through a single point of contact for instruments, software, and solutions. KeysightCare covers an extensive group of instruments, application software, and solutions and ensures optimal uptime, faster response, faster access to experts, and faster resolution.

Keysight Services

Offering	Benefits
KeysightCare	KeysightCare provides elevated support for Keysight instruments and software, with access to technical support experts that respond within a specified time and ensure committed repair and calibration turnaround times (TAT). KeysightCare offers multiple service agreement tiers, including KeysightCare Assured, Enhanced, and Application Software Support. See the KeysightCare data sheet for details.
KeysightCare Assured	KeysightCare Assured goes beyond basic warranty with repair services that include committed TAT and unlimited access to technical experts.
KeysightCare Enhanced	KeysightCare Enhanced includes all the benefits of KeysightCare Assured plus Keysight's accurate and reliable calibration services, accelerated, and committed TAT, and technical response.
Keysight Support Portal & Knowledge Center	All KeysightCare tiers include access to the Keysight Support Portal where you can manage support and service resources related to your assets such as service requests, and status, or browse the Knowledge Center.
Education Services	Build confidence and gain new skills to make accurate measurements, with flexible Education Services developed by Keysight experts. Including Start-up Assistance.
Alternative acquisition options	
KeysightAccess	Reduce budget challenges with a subscription service enabling you to get the instruments, software, and technical support you want for your test needs.

Recommended services

Maximize your test system up-time by securing technical support, repair, and calibration services with committed response and turnaround times. 1-year KeysightCare Assured is included in every new instrument purchase. Obtain multi-year KeysightCare upfront to eliminate the need for lengthy and tedious paperwork and yearly requests for maintenance budget. Plus, you benefit from secured service for 2, 3, or 5 years.

Keysight Services

Service	Function
KeysightCare Enhanced[1]	Includes tech support, warranty and calibration
R-55B-001-1	KeysightCare Enhanced – Upgrade 1 year
R-55B-001-2	KeysightCare Enhanced – Extend to 2 years
R-55B-001-3	KeysightCare Enhanced – Extend to 3 years (Recommended)
R-55B-001-5	KeysightCare Enhanced – Extend to 5 years (Recommended)
KeysightCare Assured	Includes tech support and warranty
R-55A-001-2	KeysightCare Assured – Extend to 3 years
R-55A-001-3	KeysightCare Assured – Extend to 3 years
R-55A-001-5	KeysightCare Assured – Extend to 5 years
Start-Up Assistance	
PS-S40-01 *or* -04	Instrument fundamentals and operations starter
PS-S40-02	Optional – technology and measurement science standard learning

1. Available in select countries. For details, please view the datasheet. R-55B-001-2/3/5 must be ordered with R-55B-001-1.

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